7-20-1950

Micro-pipette remote control

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Abstract
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Disciplines
Chemistry | Engineering

UNITED STATES ATOMIC ENERGY COMMISSION

ISC-112

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July 20, 1950

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Reproduced direct from copy
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Work performed under
Contract No. W-7405 eng 82

PRINTED IN USA
PRICE 5 CENTS

AEC, Oak Ridge, Tenn., 10-20-50--675-A26147

MICRO-PIPETTE REMOTE CONTROL

J. Weber, Jr. and E. Dewell

General

A micro-pipette remote control mechanism was developed to satisfy the need for handling small quantities of extremely radioactive materials. The sampling had to be done with the complete protection of the operator by means of proper shielding. Quantities as small as 5 lambda were handled and had to be delivered with the assurance that accuracy of measurement was maintained. Ease of operation was also an element considered in the production of this mechanism.

The advantages permit sampling of extremely radioactive liquid materials with ease. The width of the range of pipettes used is almost unlimited and would depend entirely upon the number of heads constructed. Further details of the pipette heads are discussed later. The pipetting of quantities from 5 lambda to 250 lambda is typical and common practice at the Ames Laboratory.

A typical setup as used at Ames consists essentially of the remote control panel which supports the observation telescope, the control cables which link the panel to the pipette mechanism proper, and the necessary shielding, the design of which is unlimited. The control panel is self explanatory, while the pipette mechanism consists of a base and tube which support a gear assembly, which controls the pipette proper. This assembly provides a means of raising and lowering the pipette and also a means for drawing the liquid sample up into the pipette to the required graduation mark. The table may be revolved to any desired position through a gear arrangement in the base. The proper mechanical advantage has been incorporated such that ease of operation and accuracy is maintained at all times.

It might be mentioned that the uses for this instrument may be extended beyond that for which it was originally designed. In beta-ray spectrometer work, radioactive samples are often evaporated to dryness drop by drop upon the surface of a very thin mica membrane. A stop attachment limiting the downward motion of the pipette could very easily be constructed as an integral part. This could previously be set such that the lower tip of the pipette would come within the desired distance from the mica membrane, in order to deposit the drop with ease and the assurance that the membrane would not be punctured. The sample could then be rotated from beneath the pipette and placed under a heat lamp, or if fumes are objectionable, under a small hood and heater unit.

Discussion

In the construction, stainless steel was used for practically all parts, because of its resistance to the usual corrosive atmosphere of the chemical laboratories. Where a high polish could be maintained, the ease of decontamination would be facilitated. The time consumed in the manufacture of this mechanism was about 125 hours. The cost of materials and standard remote cables was $75.00. It should be pointed out that a perfectly satisfactory product could have been had by using iron and bronze in the fabrication. A light chromium plate would have provided satisfactory corrosion protection. The use of these materials, as well as the use of small rods and universal joints to replace the expensive control cables, could have substantially reduced the over-all cost.

Three cables with male ends, of the type used for remote control of radios, were employed. The cables were coupled to three large radio knobs located on the control panel.

It may be seen from Figure 1 that the operator has the advantage of observing the pipette meniscus through the telescope mounted above the control panel. This telescope is of the type used in reflecting galvonometers. The image, of course, is inverted in this case. However, this minor disadvantage may be overcome to a degree by using a large 90° prism placed immediately in front of the telescope with the plane of the hypotenuse parallel to the ground plane and line of sight. This will give an erected image vertically; however, from left to right the image will be reversed.

Photographs of the instrument and its operation are shown in Figures 1 and 2. Shielding has not been shown in this case for the sake of simplicity. If the sample is so active that even a telescope port in the shielding is prohibited, a double mirror arrangement will permit an offset of the line of sight of the telescope.

Figure 3 is a drawing showing the heart of the pipette mechanism. The small rack of the quill and its engaging pinion cause the pipette to be raised and lowered. The worm gearing at the top gives complete control of the head which is shown at the bottom with the short rubber tube for connection to the pipette. Figure 3 also shows how the various heads may be interchanged.

The wide range of pipettes used is obtained by the use of interchangeable heads. These heads are simple to construct and very easily removed for replacement by one set screw. If machined properly, a very small amount of silicon grease will provide sufficient seal, which is quite desirable in order to promote a positive action within the pipette.

Operation

Prior to the use of the instrument a pipette of the volume desired (up to 250 lambda with the present head) is attached with a short rubber connector. The hot sample is then placed on the table along with the receiving container and a rinse bath. Alignment of the vessel with the pipette is aided by centering marks cut into the rotating table at four different positions.

The hot sample is centered beneath the pipette by means of the table control and the pipette is lowered into the solution by means of the height control. After adjusting the meniscus level with the help of the telescope, the pipette is raised. The clinging drop on the pipette is touched off by coordinating the table control with the height control as the pipette is withdrawn. The receiver is then rotated into position and the pipette discharged into it. Since most micro-pipettes are calibrated to contain a given volume, the pipette must be rinsed into the receiver several times. This is done by revolving the rinse bath under the pipette and repeating the above procedure.

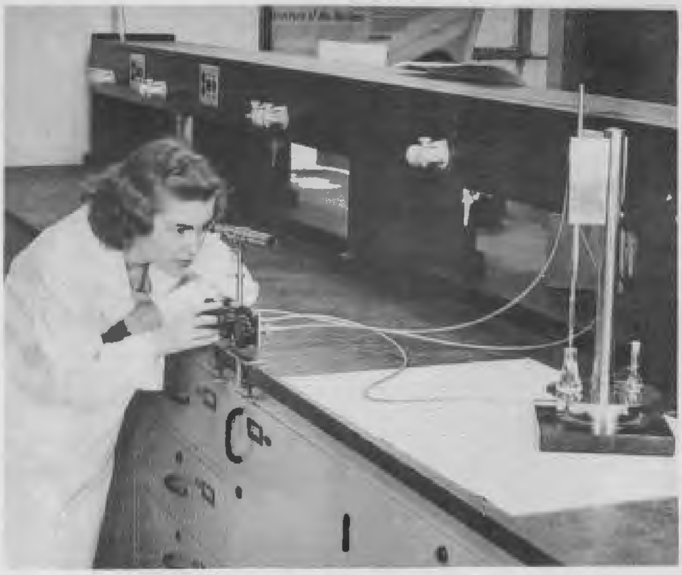

Figure 1

Figure 2

Figure 3

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